PATENT ABSTRACTS OF JAPAN

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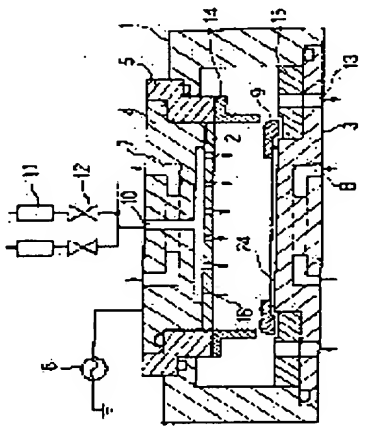
(54) DRY ETCHING DEVICE

(57)Abstract:
PURPOSE: To increase selection ratio, simplify dry etching process, exclude chamber contamination, and obtain an equipment of simple structure, by installing guartz members composed of quartz in the vicinity between an upper electrode and a lower electrode.
CONSTITUTION: In a dry etching system performing dry etching of a film formed on a silicon oxide film, quartz members 9, 14, 15 composed of guartz are installed in the vicinity between an upper electrode 2 and a lower electrode 3. For example, a clamp 9 for pressing a semiconductor wafer 24, a shield 15 fixed to an insulator 5, and a ring 15 arranged on the lower electrode 3 are made of quartz. Thereby, when the silicon oxide film is exposed, the quartz members are etched together with the silicon oxide film, so that selection ratio is increased and the thickness of the silicon oxide film is not reduced. Further, since it is not necessary to introduce deposition gas except etching gas, dry etching process is simplified, a chamber is not contaminated, and the equipment structure is simplified.



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Specification

1. [TITLE OF THE INVENTION] Dry etching apparatus

2. [CLAIMS]

[Claim 1]

A dry etching apparatus for etching a film formed on a silicon oxide film characterized in that quartz members made of quartz are placed closely between an upper electrode and a lower electrode.

3. [DETAILED DESCRIPTION OF THE INVENTION]

[Field of Industrial Application]

The present invention relates to a dry etching apparatus for etching a film formed on a silicon oxide film.

[Prior Art]

In a case where a silicon nitride (Si_3N_4) film formed on a silicon oxide (SiO_2) film is etched, the thickness of the silicon oxide film becomes small when the silicon nitride film is overetched because the ratio of etching rate of the silicon nitride film to the etching rate of the silicon oxide film, that is, the selectivity ratio of the silicon nitride film to the silicon oxide film is small.

For this reason, in conventional dry etching apparatus (JP-A No. 102232/1988, Plasma etching: selective and non-damaging (J. Dieleman, F.H.M. Sanders, June, 1984, Solid State Technology/Japanese version)), the selectivity ratio is

made larger by introducing a deposition gas other than an etching gas.

[Problems to be Solved by the Invention]

However, in such dry etching apparatus, the process of dry etching becomes complex and the chamber is easily stained by a deposition gas. Further, the structure of the apparatus becomes complicated because a system for introducing the deposition gas is necessary to be arranged.

This invention was attained to solve the above problems, and its object is to provide a dry etching apparatus in which the selectivity ratio is large, the process of dry etching is simple, the chamber is not stained, and the structure of the apparatus is simple.

[Solution to the Problems]

In order to accomplish this object, quartz members formed of quartz are placed closely between an upper electrode and a lower electrode in a dry etching apparatus for etching a film formed on a silicon oxide film in the present invention.

[Operation]

In this dry etching apparatus, when the silicon oxide film is exposed, the quartz members are etched together with the silicon oxide film because the quartz members and the silicon oxide film are made of the same material.

[Embodiment]

Fig. 1 is a cross sectional view showing part of a dry

etching apparatus according to the present invention, and Fig. 2 is a schematic cross sectional view showing the whole dry etching apparatus. In these figures, the numeral 1 represents a chamber made of aluminum, 5 represents an insulating insulator attached to the chamber 1, 4 represents a conductive upper electrode support attached to the insulator 5, 2 represents an upper electrode as a cathode electrode attached to the upper electrode support 4, 6 represents a high frequency power source connected to the upper electrode 2 via the upper electrode 4, and 3 represents a lower electrode as an anode electrode attached to the chamber 1. The lower electrode 3 is provided so as to oppose to the upper electrode 2 and kept in a grounded state. The numeral 13 represents an exhaust port provided on the lower electrode 3, 7 represents a temperature control channel provided on the upper electrode support 4, 8 represents a temperature control channel provided on the lower electrode 3, 10 represents a gas supply channel provided on the upper electrode support 4, 19 represents a gas cylinder connected to the gas supply channel 10, 11 represents a mass flow controller provided between the gas cylinder 19 and the gas supply channel 10, 12 represents a gas valve provided between the mass flow controller 11 and the gas supply channel 10, and 16 represents a gas introduction port provided on the upper electrode 2. The gas introduction port 16 is linked to the gas supply channel 10. The numeral 20 represents an auxiliary vacuum chamber attached to the chamber

1, 21 represents a vacuum pumping system connected to the chamber 1 and the auxiliary vacuum chamber 20, 22 represents a loader, 23 represents an unloader, and 14 represents a shield attached to the insulator 5. The shield 14 is made of quartz. The numeral 24 represents a semiconductor wafer placed and held on the lower electrode 3, 9 represents a clamp to hold the semiconductor wafer 24. The clamp 9 is made of quartz. The numeral 15 represents a ring arranged on the lower electrode 3. The ring 15 is made of quartz.

In this dry etching apparatus, the semiconductor wafer 24 in which a silicon nitride film is formed on a silicon oxide film is placed and held on the lower electrode 3, the inside of the chamber 1 is evacuated by the vacuum pumping system 21, and then CF_4 gas and O_2 gas are introduced inside the chamber 1 by opening the gas valve 12 as well as controlling their flow by means of the mass flow controller 11. When a high frequency power is applied by the high frequency power source 6, ions, radicals, and molecules generated between the upper electrode 2 and the lower electrode 3 collide on the surface of the semiconductor wafer 24 and react to etch silicon nitride. In this case, the silicon nitride is exhausted in the form of SiF_4, NO, and NO_2. When the silicon oxide film is exposed, the silicon oxide film is exhausted in the form of SiF_4, CO, and CO_2. In this case, the shield 14, the clamp 9, and the ring 15 are etched together with the silicon oxide film because the shield 14, the

clamp 9, and the ring 15 are made of the same material as that of the silicon oxide film. Therefore, the etching rate of the silicon oxide film becomes smaller, and thus the selectivity ratio of the silicon nitride film to the silicon oxide film becomes larger. According to the experiment carried out by the present inventors, the selectivity ratio was about 2.5 times larger compared to when the shield 14, the clamp 9, and the ring 15 were not used. Therefore, the film thickness of the silicon oxide film does not become small. Moreover, since it is unnecessary to introduce a deposition gas other than the etching gas, the process of dry etching becomes simpler and the chamber 1 is not stained. In addition, since it is unnecessary to provide a system for introducing the deposition gas, the structure of the apparatus becomes simpler. Further, the etching rate can be made uniform as well as faster because the shield 14 is provided.

Fig. 3 is a cross sectional view showing part of another dry etching apparatus according to the present invention. In the figure, the numeral 17 represents a diffusion plate attached to the upper electrode 2, and the diffusion plate 17 is made of quartz. The numeral 18 represents a diffusion hole provided on the diffusion plate 17, and the diffusion hole 18 is linked to the gas introduction port 16.

In this dry etching apparatus, since the shield 14 and the diffusion plate 17 are etched together with the silicon oxide film when the silicon oxide film is exposed, the etching rate

of the silicon oxide film becomes slower, and thus the selectivity ratio of the silicon nitride film to the silicon oxide film becomes larger. Therefore, the film thickness of the silicon oxide film does not become small.

Fig. 4 is a cross sectional view showing part of still another dry etching apparatus according to the present invention. In the figure, the numeral 25 represents a diffusion plate attached to the shield 14. The diffusion plate 25 is made of quartz. The numeral 26 represents a diffusion hole provided on the diffusion plate 25.

In this dry etching apparatus, since the shield 14 and the diffusion plate 25 are etched together with the silicon oxide film when the silicon oxide film is exposed, the etching rate of the silicon oxide film becomes slower, and thus the selectivity ratio of the silicon nitride film to the silicon oxide film becomes larger. Therefore, the film thickness of the silicon oxide film does not become small.

It should be noted that although the shield 14, the clamp 9, the ring 15, and the diffusion plate 17 or 25 were used as quartz members in the above embodiments, other quartz members may also be used.

[Effect of the Invention]

As has been explained in the foregoing, in the dry etching apparatus according to the present invention, when the silicon oxide film is exposed, the quartz members are etched together

with the silicon oxide film, and therefore the selectivity ratio becomes larger and the film thickness of the silicon oxide film does not become small. Moreover, since it is unnecessary to introduce a deposition gas other than the etching gas, the process of dry etching becomes simpler, the chamber is not stained, and the structure of the apparatus becomes simpler. Accordingly, the effect of the present invention is remarkable.

4. [BRIEF EXPLANATION OF THE DRAWING]

Fig. 1 is a cross sectional view showing part of a dry etching apparatus according to the present invention.

Fig. 2 is a schematic cross sectional view showing the whole dry etching apparatus according to the present invention.

Figs. 3 and 4 are cross sectional views of another dry etching apparatus according to the present invention, respectively.

2 upper electrode

3 lower electrode

9 clamp

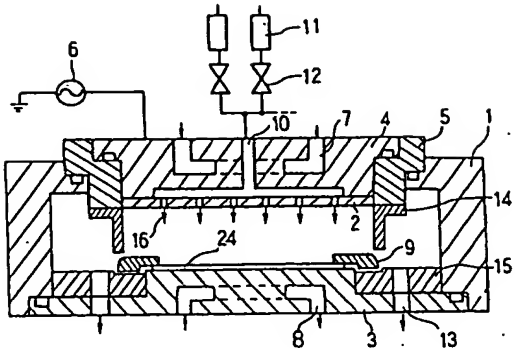
14 shield

15 ring

17 diffusion plate

25 diffusion plate

Fig. 1　第 1 図



2---上部電極
3---下部電極
9---クランプ
14---シールド
15---リング

Fig. 2　第 2 図

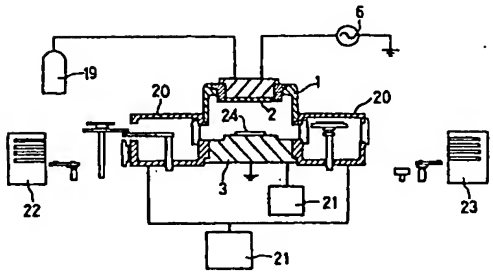


Fig. 3

第 3 図

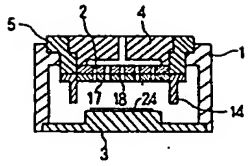
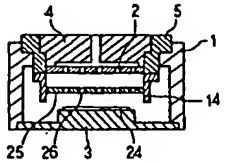


Fig. 4　第 4 図



2---上部電極
3---下部電極
14---シールド
17---拡散板
25---拡散板

2	upper electrode
3	lower electrode
9	clamp
14	shield
15	ring
17	diffusion plate
25	diffusion plate